

WHAT IS CLAIMED IS:

1. A ball given quantity supply apparatus, comprising:  
a ball storage portion for storing a plurality of balls  
therein;

5 a ball arranging device for arranging a plurality of balls  
stored in the ball storage portion in a line;

a ball delivery device including a ball passage extended  
from the ball storage portion so as not only to be able to receive  
a plurality of balls arranged in a line by the ball arranging  
10 device when the plurality of balls are supplied thereto but  
also to allow the plurality of balls supplied thereto to pass  
in a line therethrough, the ball delivery device being capable  
of delivering the plurality of balls arranged in a line in the  
ball passage from the ball storage portion to the extended end  
15 portion of the ball passage using gravity;

a first gate device disposed at a position near to the  
ball storage portion in the ball passage of the ball delivery  
device for opening and closing the ball passage;

a second gate device disposed at position more distant  
20 from the ball storage portion in the ball passage of the ball  
delivery device than the first gate device for opening and  
closing the ball passage and also for holding a given quantity  
of balls between the first gate device and itself;

a pressurized fluid jetting device disposed in the  
25 vicinity of the first gate device in the ball passage of the

ball delivery device for jetting out a pressurized fluid onto the balls to thereby separate substances attached to the surfaces of the balls from these surfaces; and

an operation control device for detecting that a given  
5 quantity of balls are held between the first and second gate device in the ball passage of the ball delivery device, and also for controlling the operations of the first and second gate device, wherein

the operation control device opens the first gate device  
10 and closes the second gate device while the plurality of balls arranged in a line by the ball arranging device are being supplied into the ball passage of the ball delivery device, and closes the first gate device and opens the second gate device after it is detected that a given quantity of balls are held between  
15 the first and second gate device in the ball passage of the ball delivery device.

2. The ball given quantity supply apparatus as set forth in Claim 1, wherein

20 the ball storage portion includes a ball receiving recessed portion for receiving a plurality of balls therein;

the ball receiving recessed portion has a structure in which the plurality of balls in the ball receiving recessed portion are arranged along a given area of the inner peripheral  
25 surface thereof due to gravity;

the ball arranging device arranges the plurality of balls along the given area of the inner peripheral surface of the ball receiving recessed portion of the ball storage portion in a line; and

5 the ball passage of the ball delivery device is open in the ball receiving recessed portion of the ball storage portion along the given area of the inner peripheral surface of the ball receiving recessed portion of the ball storage portion, and is supplied with the plurality of balls arranged in a line  
10 by the ball arranging device through the opening thereof.

3. The ball given quantity supply apparatus as set forth in Claim 1, wherein

the cross section of the ball passage has a polygonal  
15 shape.

4. The ball given quantity supply apparatus as set forth in Claim 3, wherein

the pressurized fluid jetting device jets out the  
20 pressurized fluid into between the outer peripheral surfaces of the balls passing through the ball passage and at least one of a plurality of corners of the polygonal shape of the cross section in the cross section of the ball passage.

5. The ball given quantity supply apparatus as set forth in Claim 1, further comprising:

a pressurized fluid discharge device disposed in the vicinity of the first gate device and at a position nearer to the extended end portion than the second gate device in the ball passage of the ball delivery device for discharging the pressurized fluid jetted from the pressurized fluid jetting device into the ball passage to the outside of the ball passage.

6. The ball given quantity supply apparatus as set forth in Claim 1, wherein

the pressurized fluid jetting device jets out the pressurized fluid intermittently.

7. The ball given quantity supply apparatus as set forth in Claim 1, wherein

the operation control device includes:

a first ball detector disposed in the ball passage of the ball delivery device so as to adjoin the downstream side of the first gate device, and

a second ball detector disposed in the ball passage of the ball delivery device so as to adjoin the upstream side of the second gate device.

8. The ball given quantity supply apparatus as set forth in Claim 1, wherein

the ball arranging device includes:

5 a ball forced supply device for supplying forcibly the plurality of balls arranged in a line by the ball arranging device to the ball passage of the ball delivery device.

9. The ball given quantity supply apparatus as set forth in Claim 1, further comprising:

10 a ball passage number count device disposed on the downstream side of the second gate device in the ball passage of the ball delivery device for counting the number of balls having passed through the ball passage.

15 10. The ball given quantity supply apparatus as set forth in Claim 9, wherein

the ball passage number count device includes an optical sensor, and

the pressurized fluid is jetted onto the optical sensor.

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11. The ball given quantity supply apparatus as set forth in Claim 1, further comprising:

a hand-operated ball supply device disposed in the ball passage of the ball delivery device so as to communicate with

25 the downstream side of the second gate device.

12. The ball given quantity supply apparatus as set forth in Claim 11, wherein

the hand-operated ball supply device includes:

a funnel-shaped ball throw member,

5 a ball guide member extended from the central portion of the bottom surface of the ball throw member to the downstream side of the second gate device in the ball passage of the ball delivery device so as to communicate with the present downstream side, and

10 a ball mixing device for mixing a plurality of balls thrown into the ball throw member to thereby prevent the plurality of balls from being clogged in the entrance of the ball guide member.

15 13. The ball given quantity supply apparatus as set forth in Claim 11, further comprising:

a ball passage number count device disposed downstream of the communicating portion of the hand-operated ball supply device in the ball passage of the ball delivery device for  
20 counting the number of balls having passed through the ball passage.

14. The ball given quantity supply apparatus as set forth in Claim 13, wherein

25 the ball passage number count device includes an optical

sensor, and

the pressurized fluid is jetted onto the optical sensor.

15. A method for assembling a ball screw apparatus,

5 comprising the steps of:

loosely fitting a nut with a circulating part previously assembled thereto with a provisional shaft including a tapered step portion formed between a small-diameter shaft portion and a large-diameter shaft portion thereof;

10 in this state, fitting a ball insertion jig into between the provisional shaft and the nut from the small-diameter shaft portion and rotating the provisional shaft to introduce a given number of balls inserted from the ball passage of the ball insertion jig into between the screw groove of the nut and the  
15 provisional shaft through a guide portion formed between the ball insertion jig and the tapered step portion;

moving the provisional shaft to the small-diameter shaft portion side with respect to the nut and the ball insertion jig to allow the balls existing in the guide portion to climb  
20 over the tapered step portion,

introducing the balls into between the screw groove of the nut and the provisional shaft; and

fitting the screw shaft of the ball screw apparatus with the nut.

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16. The method for assembling a ball screw apparatus as set forth in Claim 15, wherein

when introducing the balls into between the screw groove of the nut and the provisional shaft, the nut is made eccentric  
5 to the provisional shaft.

17. An apparatus for assembling a ball screw apparatus, comprising:

a provisional shaft which includes a tapered step portion  
10 formed between a small-diameter shaft portion and a large-diameter shaft portion thereof and also with which a nut of the ball screw apparatus with a circulating part previously assembled thereto can be loosely fitted;

a drive device for rotating the provisional shaft;

15 a ball insertion jig fittable into between the provisional shaft and the nut from the small-diameter shaft portion, including a ball passage for receiving a given number of balls, defining a guide portion between the tapered step portion and itself, and capable of introducing the balls inserted into the  
20 ball passage into between the provisional shaft and a screw groove formed in the nut, and

a moving device the provisional shaft to the small-diameter shaft portion side with respect to the nut and the ball insertion jig.

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18. The apparatus for assembling a ball screw apparatus as set forth in Claim 17, wherein

the ball insertion jig includes:

5 a ball stopper disposed on the ball exit side of the ball passage so as to separate the ball exit portion or ball entrance portion of the circulating part from the guide portion in order to be able to prevent the balls introduced into between the screw groove of the nut and the provisional shaft from interfering with the balls inserted from the ball passage; and  
10 a projection for preventing the balls inserted from the ball passage from touching directly the groove shoulder of the screw groove of the nut, said projection being disposed on the leading end portion of the ball stopper.

15 19. The apparatus for assembling a ball screw apparatus as set forth in Claim 17, wherein

an elastic member is applied to, buried in, shrinkage fitted with, or bonded to the outer peripheral surface of the provisional shaft including the tapered step portion.

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